WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

# Environmental Impact Statement (EIS) for Permitted Use of Triclopyr

## Draft

February 2004
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Washington State Department of Ecology
Water Quality Program

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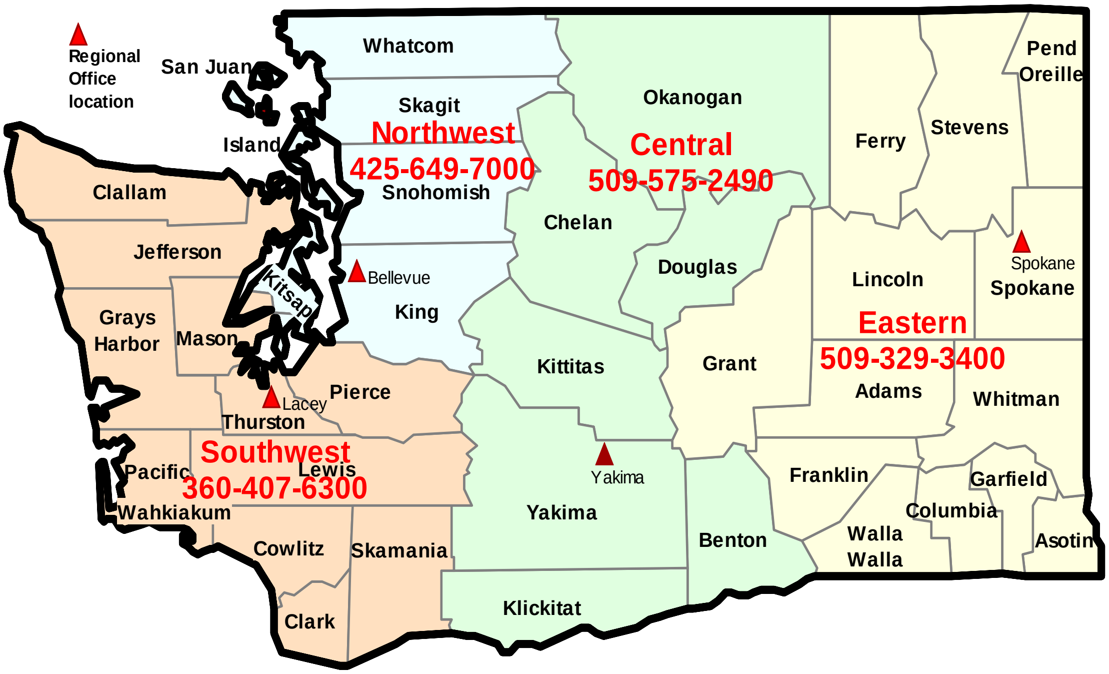


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# Draft Environmental Impact Statement (EIS) for Permitted Use of Triclopyr Under Ecology's Water Quality Program

This draft EIS is a supplement to the Final Supplemental Environmental Impact Statement for Freshwater Aquatic Plant Management (Ecology, 2001). The purpose of this Supplemental Environmental Impact Statement is to review what is known about the potential environmental effects of aquatic uses of triclopyr. This includes a summary of the registration status, environmental effects, potential human health impacts, and recommended mitigation to minimize the effects of triclopyr application. This information is designed to follow closely the State Environmental Protection Act (SEPA) Checklist. Except where otherwise noted, references to the 2001 triclopyr risk assessment prepared for Ecology by Compliance Services International (CSI) Volume 5 Triclopyr, Sections 1 – 5. Mitigations for the use of triclopyr in Washington waters that go beyond label conditions are bulleted in each section and summarized at the end of this document.

## 1. Registration Status

Triclopyr TEA (triethylamine) was first registered by Dow AgroSciences on May 8, 1979 as an herbicide on non-crop areas and in forestry use for the control of broadleaf weeds and woody plants. In 1984, it was registered for use on turf sites. In 1995, triclopyr TEA was registered for use on rice to control many hard to control broadleaf weed species. EPA's Re-registration Eligibility Decision (RED) process for triclopyr acid, triclopyr TEA and triclopyr BEE (butoxyethyl ester) was completed on September 30, 1997. The on-line RED can be viewed at http://www.epa.gov/oppsrrd1/REDs/2710red.pdf.

Garlon® 3A (EPA Reg. No. 62719-37) from Dow AgroScience is currently registered in the state of Washington for the control of aquatic weeds in public water ways and annual and perennial broadleaf weeds and woody brush in wetlands.

November 2002, SePRO Corporation received Federal EPA registration for Triclopyr TEA salt under the trade name (EPA Reg. No. 62719-37-67690). The Renovate® label specifies selective control of nuisance and exotic plants such as Eurasian watermilfoil (*Myriophyllum spicatum*), purple loosestrife (*Lythrum salicaria*), alligatorweed (*Alternanthera philoxeroides*), and water hyacinth (*Eichhornia crassipes*).

DowElanco currently manufactures and distributes Garlon® 3A and SEPRO Corporation will market and distribute Renovate® under a separate label. The products will be the same since DowElanco will manufacture both products.

## 2. Description

*What triclopyr is used for*

Triclopyr, ((3,5,6-tricholoro-2-pyridinyl) oxyacetic acid) is an aquatic herbicide that utilizes a systemic mode of action used to control submerged, floating and emergent aquatic plants in both static and flowing water. It is also registered for a number of terrestrial uses including broadleaf weed control, and is used in rice, pasture and rangeland, rights-of-way, forestry, turf, and home lawns and gardens.

*Other ingredients in the triclopyr formulation*

Triclopyr is formulated as a solution in water. Intentionally added inert or “other” ingredients in triclopyr formulations include water and triethanol amine (TEA). The water serves as the primary diluent/solvent in the liquid product while the triethanol amine is used to form the salt of the technical grade active ingredient. There are no known impurities identified by the manufacturers or the US EPA that are known to be of toxicological or environmental concern.

*How triclopyr works*

Triclopyr is a growth hormone of the *auxin* type. An auxin-type herbicide interferes with growth after the plant emerges. It contacts leaves, where sugar is produced, and moves to roots, tips, and parts of the plant that store energy, thereby interrupting growth. Since the movement of sugars from the leaves to other parts of the plant is essential for growth, this type of herbicide has the potential to kill simple perennial and creeping perennial weeds with only one or two foliar applications. Bending and twisting of leaves and stems is evident almost immediately after application. Delayed symptom development includes root formation on dicot stems: misshapen leaves, stems and flowers; and abnormal roots (EPA, 1998) (Purdue, 2000).

*What target aquatic plants triclopyr affects*

Triclopyr has been claimed to be effective for a variety of fully or partially aquatic plants including American lotus (*Nelumbo lutea*), Eurasian watermilfoil (*Myriophyllum spicatum*), parrotfeather (*Myriophyllum aquaticum*), pennywort (*Hydrocotyle* spp.), waterhyacinth (*Eichhornia crassipes*), water lilies (*Nuphar* spp. and *Nymphaea odorata*) and waterprimrose (*Ludwigia uruguayenis*), alligatorweed (*Alternanthera philoxeroides*) and purple loosestrife (*Lythrum salicaria*).

*What aquatic plants triclopyr does not affect*

Triclopyr is not typically used for algae control and most species of algae are not affected strongly by triclopyr (Section 4, Tables 2, 11 and 16). Many species of native plants are not affected by triclopyr or are not affected except transitorily. Some of these may include pondweed species and coontail, rushes and cattails (Petty et al, 1998). However, at higher use rates (2.5 ppm a.e.), the more susceptible native species such as coontail, Southern naiad, and American waterweed may be reduced in numbers in some treatment situations.

*Physical and chemical characteristics of triclopyr*

Triclopyr dissolves readily in water but is not volatile. It has a low vapor pressure (1.26x $10^{-6}$ mm/Hg at 25° C for the active ingredient triclopyr), and a low distribution coefficient (0.165 to 0.925 mL/g). *Hydrolysis* refers to the chemical interaction of the chemical with water as a mechanism of chemical breakdown. Triclopyr acid, which forms immediately when Triclopyr TEA dissolves in water, is not hydrolyzed.

*Degradation mechanisms and products*

The main degradation products of triclopyr in the environment occur because of photolysis or microbial degradation.

- *Photolysis*

  Photolysis, or chemical breakdown due to sunlight, can contribute substantially to the degradation of triclopyr acid and triclopyr TEA. These triclopyr products are degraded rapidly under natural sunlight (0.6 to 6.6 days) with both the dominant degradate and degradation rate varying somewhat with the product tested (EPA RED, 1998).

  In sterile buffered water, photolysis of triclopyr acid (dissociated triclopyr TEA) produced MDPA (5-chloro-3, 6-dihydroxy-2-pyridinyloxyacetic acid) with small amounts of oxamic acid and carbon dioxide [EPA RED (1995) p. 53 and Woodburn et al (1993)]. In natural river water, photolysis produced mainly oxamic acid.

- *Microbial Degradation*

  In aerobic soils, triclopyr degrades to carbon dioxide. Intermediate degradation products include TCP *(3,5,6-trichloro-2-pyridinol)* and TMP *(3,5,6 tricloro-2- methoxypyridine).*

*Persistence*

The persistence of triclopyr and its degradates varies widely depending on the conditions of the system being tested. For the most part, triclopyr is dissipated rapidly from the water column and is not adsorbed on sediment for very long periods of time.

In soils, factors that effect persistence of triclopyr include temperature, pH, higher organic matter content, higher microbial numbers, and the presence of triclopyr due to previous applications. Half-life persistence can range from less than one day to nearly a year (Section 3, Table 3.4, p. 31). A Dow AgroSciences product (trade name Confront, containing 33% Triclopyr TEA) was not broken down by composting operations produced at a publicly owned solid waste facility in Spokane County, Washington, where it tainted at least 47,000 cubic yards of compost. The presence of the herbicide Confront rendered the compost damaging to crops and resulted several claims to the waste facility. It is unknown whether triclopyr or the herbicide's other active ingredient, clopyralid triethylamine salt (12.1%) was at fault for contaminating the compost (See: County wants Dow Chemical to stop distributing herbicide, The Spokesman Review, Spokane, WA, 4/25/01).

*Persistence in water*

The environmental persistence of triclopyr products in the field can be quite variable; the dissipation half-life in water varies from less than 1 day to approximately 7.5 days. However, according to most authors, the most typical half-life would be between 3.5 and 7.5 days (CSI, Volume 5, Section 3, Table 3.5, p. 55). Dissipation of triclopyr is primarily due to photolysis, degradation by microbes, and mixing of triclopyr treated water with water that has not been treated.

Dissipation is related to lake size, wind, and the amount of water exchange that occurs. The larger the lake, the more wind blowing across the lake surface, the more water exchange through inlet and outlet streams or rivers, the more likely it is that triclopyr residues will be rapidly dispersed and diluted to below detection limits. In small lakes, detectable concentrations of triclopyr may be carried a significant distance down an outlet stream if the flow is sufficient and degradation is slow.

The concentration of the toxic metabolite (TCP) has generally been low in lake and pond water with concentrations of TCP not higher than ~0.1 ppm in Lake Minnetonka, Lake Seminole, and various ponds on the day of application. It generally dissipates to concentrations below the detection limit at three days after treatment.

*Persistence in water - anaerobic conditions*

Anaerobic environments lack oxygen. According to studies, triclopyr in anaerobic aquatic sediment may have a very long half-life. For example, it can take a year for 20% of the amount of triclopyr to degrade in these environments. The calculated rate for 50% to degrade is about 3 and 1/2 years.

*Persistence on sediments*

In the Lake Minnetonka study, the half-lives of triclopyr in the sediment ranged from around five or six days at Lake Minnetonka, and the sediment half lives of TCP were approximately eleven days.

*Persistence in aerobic soil*

Laboratory studies indicate that triclopyr acid and the dissociated triethylamine (TEA) are readily degraded in aerobic soil. The half-lives of triclopyr acid and triclopyr TEA can vary from just a few days in laboratory aerobic soil metabolism experiments to approximately two weeks on Northern Ontario forest soils to nearly three months in pastureland in Oregon (DT50 = 75 to 81 days) (SEIS, Vol. 5, Sect. 3, Table 3.4).

When the break-down products TCP and TMP were measured in the field, it is clear that TMP is not persistent and never exceeds 0.06 ppm in any soil profile on bare ground and pastureland soil. Concentrations of TCP have been observed at 0.1 to ~0.2 ppm or higher for three-quarters of a year or longer after application of triclopyr to pasturelands.

*Persistence in rice paddy soils at various depths*

In the laboratory, rice paddy soils yielded half-lives that varied considerably. Rates of degradation on surface soils (DT50 = 9 to 307 days) was much greater than on soils taken from depths of about one foot (DT50 = 35 to 314 days). This phenomenon was attributed to the fact that surface soils when compared to subsurface soils had higher pH, higher organic matter content, higher microbial numbers, and the presence of acclimated versus non acclimated decomposers (microbes).

## 3. Environmental and Human Health Impacts

### Air

Triclopyr products have very little tendency to affect air quality or cause crop damage because of low vapor pressure. (The vapor pressure of commercial products of triclopyr is $1.26 \times 10^{-6}$ mm/Hg at 25° C for the active ingredient triclopyr).

Typically, the mode of application is **subsurface injection** for liquid formulations, making drift outside the treatment area unlikely.

For those cases where a **boom sprayer** applies a liquid formulation, as much as one percent of the application may drift out of the treatment area. It has been estimated for general herbicides that this amount of drift could have an impact if 120 swaths were applied and one percent of the applied pesticide drifted out of the treatment area on each pass. In this case, dosage levels higher than that intended for the target could accumulate downwind of the treatment area. This could cause an effect on non-target plants that may damage habitat and decrease the amount of forage available for waterfowl and fish in non-target areas (Forsythe et al, 1997).

For **aerial application**, as much as 17 percent of the treatment would not strike the target area. In this case, drift out of the treatment area could impinge on non-target organisms at a great distance from the site of application. Depending on how much triclopyr was deposited per unit area outside the site, there could be a significant impact on non-target wild plants or crops. In addition to effects on plants, non-target sensitive terrestrial wildlife may be adversely impacted.

**Odor** is unlikely to be noticed except for short periods of time following application. Since there would rarely be more than one or two applications of triclopyr per water body per year in the state of Washington, any adverse impact on quality of life due to problems with odor from triclopyr applications should be weighed carefully with the impact due to the effects of poor navigability, and effects on the recreational use of the water body.

**Direct effects from breathing** the vapor are unlikely for the general public since the acute $LC_{50}$ for triclopyr TEA is greater than 2.6 mg/L (EPA RED, 1998). However, EPA has determined that there are potential exposures to persons involved in mixing, loading or entering treated sites after application is complete.

**Release of Toxic Materials – Inhalation** The Washington State Department of Health conducts a Pesticide Surveillance Program and has documentation of seven human exposure cases, possibly related to terrestrial use, involving skin and upper respiratory tract irritation following direct exposure to triclopyr spray mist. No signs and symptoms of systemic poisoning were reported, however some of the individuals experienced temporary irritation of the skin and upper respiratory tract. It should be noted that application of the triclopyr product Renovate® Aquatic Herbicide is directly injected under the water and not applied by aerial or spray application (WDOH, 1999).

For **aerial application**, as much as 17 percent of the treatment would not strike the target area. In this case, drift out of the treatment area could impinge on non-target organisms at a great distance from the site of application. Depending on how much triclopyr was deposited per unit area outside the site, there could be a significant impact on non-target wild plants or crops. In addition to effects on plants, non-target sensitive terrestrial wildlife may be adversely impacted.

### *Permit Mitigations*

*Drift*

Follow label instructions.

*Aerial applications*

- Aerial applications are not permitted in Washington State waters.

*Odor*

No odor problems were cited in the literature.

*Inhalation*

Follow label instructions.

## Earth

*Soils*

The presence of triclopyr in soil is not anticipated from aquatic treatment unless flooding occurs or the water is used for irrigation.

*Flooding*

If a flooding incident occurs within 120 days of application, there is a potential for triclopyr to damage upland sensitive species, particularly grapes, tobacco, vegetable crops and flowers. However, the expected half-life on soils is fairly low (8 to 18 days in the laboratory and two weeks in the field). Therefore, any adverse impact due to a flooding incident is likely to be quite limited.

*Sediment*

In typical situations where water is fairly shallow (0.3 to less than two meters), triclopyr in sediment has observed half-lives that range from less than one day at Lake Seminole to 5.8 days in Lake Minnetonka.

Due to the low distribution coefficient for triclopyr (0.165 to 0.925 mL/g), it does not bind tightly to sediment and therefore concentrations in sediment should remain low. This assumption is confirmed by results from field studies. For example, at Lake Minnetonka, concentrations of triclopyr in sediment were never higher than 0.334 ppm a.e. and dissipation to concentrations of $\leq$0.15 ppm was seen within 14 days after application. At Lake Seminole, triclopyr was not seen at significant concentrations (<0.1 ppm a.e.) except for the day of application where concentrations as high as 0.64 ppm a.e. were detected. Even in the pond studies, the concentration of triclopyr in sediment was very low and did not exceed 0.86 ppm a.e. during the first few days and dissipated to below the limit of quantification within four weeks.

These low levels of triclopyr in sediment indicate that the sediment quality should remain high in treated water bodies and that such sediments should pose little or no threat to benthic in-fauna.

*Metabolites*

The toxic metabolite TCP is found at even lower concentrations than triclopyr. Both laboratory and field studies indicate the concentrations of TCP in the sediment are very low and generally do not exceed 0.16 ppm and are typically less than 0.05 ppm in lakes and ponds. TCP generally dissipates to below the level of quantification within a few days of application to lakes but may take up to six weeks to dissipate entirely from ponds.

Another metabolite (TMP) is rarely detected in lake or pond sediment and is normally detected in the water column at concentrations that do not exceed 0.01 ppm a.e. TMP is generally considered to have no toxicological significance. Data supporting these conclusions can be found in Getsinger et al, (2000) Petty et al (1998) and Green et al (1989) (Table 5).

*Anaerobic conditions*

Triclopyr from the application of Garlon® 3A or Renovate® may have long half-lives in deep sediments under anaerobic conditions. In anaerobic conditions, triclopyr degrades to TCP with a half-life of about 3.5 years (Ladowski and Didlack (1984 in Petty et al, 1998).

### *Permit Mitigations*

*Irrigation*

Follow label instructions.

*Sediments*

- Due to the possibility of anaerobic conditions in sediments, sediment monitoring is required prior to any third application of triclopyr on a site within a three-year period. Evidence of persistence of triclopyr or TCP in sediments is basis for denial of the third application.

## Water

*Surface Water*

The concentrations of triclopyr in lakes that have been spot treated generally fall below the temporary drinking water residue tolerance (0.5 ppm a.e.) within one day but in rare instances can take as long as eight days. However, the concentration of triclopyr in ponds can take three to four weeks to dissipate to concentrations below 0.5 ppm a.e. (CSI, Volume 5, Sect. 3, Table 3.5, pp. 55-67).

The concentration of the toxic metabolite (TCP) has generally been low in lake and pond water with concentrations of TCP not higher than ~0.1 ppm in Lake Minnetonka, Lake Seminole, and various ponds on the day of application and generally dissipating to concentrations below the detection limit at three days after treatment.

Fish and other aquatic organisms need oxygen to survive and treatment of dense weed areas may result in dissolved oxygen decreases due to the decomposition of dead weeds. Therefore, application of triclopyr TEA products must be limited to a portion of the water body at any one time. Typically, the entire water body is typically not treated. Only about 20% of a water body is typically treated based on areas designated for priority control.

*Wetlands*

Because of the manner in which triclopyr products are applied, significant impact to other wetland environments is unlikely. There may be some tendency for drift into other wetland environments or a flow of water into estuarine, palustrine, riparian, lentic or lotic environments. However, it is not anticipated that the impact would be measurable due to dilution effects, as treated ponds, lakes, and canals normally flow into streams and rivers and ultimately into estuaries.

The total application of these products should not exceed 2.5 ppm a.e. for the treatment area per annual growing season. The total application of these products to control floating and emerged weeds should not exceed two gallons formulation/acre per annual growing season.

*Estuarine (Intertidal) Environments*

Water from a stream or river containing triclopyr may flow into an estuary. However, dilution effects from the water already present in the estuary and diurnal tides should dilute triclopyr to levels where it is not significant in the water column.

*Palustrine (Marshy) Environments*

Most immersed plants are not likely to be adversely impacted at the concentrations of triclopyr used to control fully aquatic weeds. However, floating (*Eicchornia crassipes*) and rooted submersed plants (*Myriophyllum* spp. and *Hydrocotyle* spp.), that are typically found in a palustrine environment may be affected by water that enters these areas from lakes and ponds.

It is unclear exactly how high the triclopyr concentrations must be to damage native plant species. Initial triclopyr concentrations of 2.5 ppm a.e. that remained at levels of 1.0 ppm a.e. or higher for 7 to 14 days have been known to adversely impact coontail (*Ceratophyllum* spp.), Eurasian watermilfoil (*Myriophyllum spicatum*), southern naiads (*Naja guadalupensis*), and American waterweed (*Elodea canadensis*) in water impounds (ponds) located at Elk Grove, California, Columbia, Missouri, or Lewisville, Texas (Petty et al, 1998). If these rooted macrophytes were destroyed due to herbicide applications, there would be less tendency for the marsh to flood, resulting in loss of habitat for fish, amphibians, wild birds and mammals.

## *Permit Mitigations*

*Surface water*

Follow label directions.

*Wetlands*

- The total application should not exceed 2.5 ppm a.e. for the treatment area per annual growing season. The total application to control floating and emerged weeds should not exceed 2 gallons formulation/acre per annual growing season.

## Plants

*Selectivity*

Triclopyr TEA controls invasive species of aquatic macrophyte including Eurasian watermilfoil (*Myriophyllum spicatum*), parrotfeather (*Myriophyllum aquaticum*), waterhyacinth (*Eichhornia crassipes*), alligatorweed (*Alternanthera philoxeroides*), and purple loosestrife (*Lythrum salicaria*).

Triclopyr TEA does not control desirable native species like rushes (*Juncales* spp. and *Scirpus* spp.), cattails (*Typha* spp.), duckweed (*Lemna* spp.), Flatstem pondweed (*Potamogeton zosteriformis*), Coontail (*Ceratophyllum demersum*), Southern naiad *(Najas guadalupensis*), American pondweed (*Elodea canadensis* and water paspalum (*Paspalum fluitans*), and most species of algae including the green algae (*Spirogyra* spp., *Cladophora* spp., *Mougeotia* spp. *Volvox* spp., *Closterium* spp. and *Scenedesmus* spp.), *Chara* spp. and *Anabaena* spp. (Getsinger et al, 2000; Woodburn et al, 1993; Petty et al, 1998 and Green et al, 1989, Foster et al, 1997, Woodburn, 1988 and Houtman, 1997).

*Non-target Aquatic Species*

Sensitive non-target aquatic species of plants are not likely to be affected at triclopyr concentrations of 2.5 ppm or less. At higher concentrations (2.5 ppm a.e.), southern naiad, American waterweed and coontail may be adversely impacted.

*Algae*

Sensitive non-target aquatic species of algae are not likely to be affected at triclopyr concentrations of 2.5 ppm or less.

*Endangered Plant Species*

Acute risk and endangered plant species levels of concern from runoff of triclopyr triethylamine salt during ground application are exceeded at ≥ 9.0 lb a.e./A (non-target plants inhabiting adjacent acreage) and ≥ 1.5 lb a.e./A (non-target plants inhabiting semi-aquatic areas) (Triclopyr RED). Aquatic use rates for this material are well below the use rates listed. Therefore, little or no harm to non-target terrestrial plants is expected due to either over-spray or the use of triethylamine salt treated irrigation water.

The total application of these products should not exceed 2.5 ppm a.e. for the treatment area per annual growing season.

*Spray Drift*

Spray drift has the potential to damage sensitive terrestrial plants. Species of plant that appear to be especially susceptible are grapes, tobacco, vegetable crops and flowers or other desirable broadleaf plants. Even with low drift, onions and sunflowers may be adversely affected by rates of application typically used to control floating and emergent weeds (6 lbs a.e/acre) or wetland non-crop weeds (9 lbs a.e./acre). For example, treatment rates as low as 0.12 to 0.005 lbs a.e./acre lbs/acre may cause 25% damage to these sensitive crop species (EPA RED, 1998) (Table 9). These rates are exceeded even when drift is low (1% to 5%). Small amounts of drift can be an issue if many swaths are applied, and particularly if the product is applied from an aircraft (Forsythe et al, 1997).

### *Permit Mitigations*

*Plants and algae*

Use as directed by the label.

*Endangered plant species*

- The total application of these products should not exceed 2.5 ppm a.e. for the treatment area per annual growing season.

## Animals

*Freshwater Invertebrates*

Triclopyr TEA and triclopyr acid are practically non-toxic to aquatic invertebrates and are not anticipated to be an acute or chronic risk due to their fairly short half-life (typically <5 days), low intrinsic toxicity to animals, and low tendency to accumulate in animal tissue.

While formulated triclopyr is not believed to be toxic to invertebrates, higher treatment rates (2.5 ppm a.e.) present a low to moderate risk.

Observed toxicity values for *Daphnia magna* (LC50 = 376 ppm a.e.), grass shrimp (LC50 = >234 ppm a.e.), pink shrimp (LC50 = 281 ppm a.e.), fiddler crab (>314 ppm a.e.) and crayfish (LC50 >103 ppm a.e.) place triclopyr TEA in the EPA's ecotoxicology categories of slightly toxic to practically non-toxic.

Other species of invertebrates are virtually unaffected by triclopyr TEA. For example, all other species of invertebrates that were tested have an LC50 of >100 ppm a.e.

In the field where triclopyr TEA was used to control Eurasian watermilfoil, waterhyacinth, or purple loosestrife, no invertebrate mortality or changes in invertebrate population structure was seen that could be attributed to the use of triclopyr TEA (Petty et al, 1998, Green et al, 1989 and Gardner and Grue, 1996, Houtman et al, 1997, Foster et all, 1997 and Woodburn, 1988).

*Amphibians*

No laboratory work was conducted on the effects of triclopyr TEA against amphibians. It is anticipated that amphibians will be affected by triclopyr TEA both acutely ($LC_{50}$ = 82 to 182 ppm a.e. = 114 to 254 ppm a.i.) and chronically (MATC = 27 to 61 ppm a.e. = 38 to 93 ppm a.i.) at concentrations similar to that affecting fish. What little data is available from the field indicates that *Rana pipiens* adults and tadpoles remain common 11 weeks after treatment of the Columbia, Missouri pond site at rates of 2.5 ppm a.e. (Petty et al, 1998).

*Avain/Birds*

Triclopyr acid is *slightly toxic* to birds when orally dosed or consumed in the diet. The triethylamine salt is *slightly toxic to practically non-toxic* when orally dosed or consumed in the diet. Reproduction of birds may be affected at levels greater than 100 ppm (RED).

Toxicity studies indicate that triclopyr and its products used as aquatic herbicides do not pose a significant acute or chronic risk to wild birds.

*Fish, free-swimming aquatic invertebrates, and benthic invertebrates*

Most species of fish are tolerant of triclopyr TEA. Sensitive and environmentally relevant species such as the various salmon species (*Onchorhynchus* spp.) have demonstrated LC50s that range between 96 and 182 ppm a.e. (Wan et al, 1987). These toxicity values place triclopyr TEA in the US EPA's ecotoxicological categories of slightly toxic (LC50 = >10 to 100 ppm) to practically non-toxic (LC50 = >100 ppm).
There have been no verified cases of toxicity to fish when triclopyr is used at the maximum use rate of 2.5 ppm a.e. When mortality occurs in the field after the use of triclopyr for the control of aquatic weeds, it is usually very low ($\leq$11%) and attributable to an oxygen slump due to the presence of rapidly growing non-target aquatic plant species (Petty et al, 1998).

Triclopyr acid has been reported to be practically non-toxic to rainbow trout (LC50 = 117 ppm a.e. for rainbow trout) and bluegill sunfish (96-hour LC50 of 148 ppm a.e.) (Section 4, Tables 2, 17 and 18). Other authors have reported triclopyr acid to be moderately toxic with 96-hour LC50s ranging from 5.3 ppm a.e. for pink salmon (*Oncorhynchus gotbuscha*) to 9.6 ppm a.e. for Chinook salmon *(Oncorhynchus tshawytscha*).

Triclopyr TEA is generally safe to fish, free-swimming aquatic invertebrates, and benthic invertebrates when the $EC_{50}/LC_{50}$ is compared to typical four-day time-weighted average expected environmental concentration (TWA- EEC). However, when the toxicity of triclopyr is compared to other pesticides, it is classified according to the U.S. EPA Ecotoxicological Categories as slightly toxic ($LC_{50}$ = >10 to 100 ppm) to embryo/larval and juvenile eastern oyster (*Crassostrea virginica*) rainbow trout (*Onchorhynchus* *mykiss*), tidewater silverside (*Mendia beryllina*), chum salmon (*Onchorhynchus keta*) and fathead minnow (*Pimephales promelas*). However, triclopyr TEA is classified as practically non-toxic ($LC_{50}$ >100 ppm ) to bluegill sunfish (*Lepomis macrochirus*), other salmon species (*Onchorhynchus* spp.), Daphnia magna, grass shrimp (*Palaemonetes pugio*), pink shrimp (*Penaeus durorarum*), fiddler crab (*Uca pugialtor*), and red swamp crayfish (*Procambarus clarki*). In general, triclopyr TEA can be considered to have very low toxicity to environmentally relevant fish and aquatic invertebrates. Triclopyr TEA appears to be extremely safe for use in the presence of threatened and endangered salmonid game-fish.

Triclopyr TEA appears to be safe for use in aquatic ecosystems. When comparing typical expected environmental concentrations (EEC) of triclopyr with laboratory $LC_{50}$s, the highest concentration that may be encountered immediately after application (2.5 ppm a.e. for control of submerged weeds or 4.4 ppm a.e. for control of floating and emerged weeds in shallow water) may affect more sensitive species. Fish and non-mollusk species would not be adversely impacted by these concentrations of triclopyr TEA. For example, the most sensitive fish species is rainbow trout with a 96-hour $LC_{50}$ of 82 ppm a.e. and the most sensitive non-mollusk invertebrate is the red swamp crayfish with a 96-hour $LC_{50}$ of >103 ppm a.e. Since these species have $LC_{50}$s that are >10-fold greater than the EEC that occurs immediately after application, it is not likely that they would be adversely impacted by the effects of triclopyr TEA. However, the most sensitive mollusk is the embryo larval stage of the eastern oyster with a 48-hour $EC_{50}$ for improperly developed embryo/larvae of 22 ppm a.e. Since the risk quotient generated from this $LC_{50}$ and the lowest initial EEC is greater than the low level of concern (0.1), this segment of the biota may be harmed by exposure to triclopyr TEA. However, since the risk quotient is not higher than the high level of concern (0.5), this segment of the biota will probably not be adversely impacted if triclopyr is classified and used as a restricted use aquatic herbicide ($RQ = EEC/EC_{50}$ = 4.4 ppm a.e./22 ppm a.e. = 0.2). Some concern has been expressed that the eastern oyster in not an appropriate species to use in evaluations of risk for compounds that may not be used legally in estuaries. Furthermore, any concentration of triclopyr TEA entering an estuary would be greatly diluted by both untreated river/creek water and untreated sea water from the tidal action (CSI, Volume 5, Section 4, p. 63-64).

*Sea water challenge tests for salmon*

The following seawater challenge tests were done in support of the noxious weed control program at Ecology.

> **Effects of Three Aquatic Herbicides on Smoltification in Juvenile Pacific Coho Salmon** by King, KA[1], CE Grue[1], JM Grassley[1], CA Curran[1], WW Dickhoff[2], and JA Winton[3]
>
> Herbicides are frequently used to control exotic or nuisance aquatic plants. Utilization of herbicides in Integrated Pest Management (IPM) plans to control aquatic weeds has been hampered by court injunctions directed at the non-target

toxicity of active herbicidal ingredients. Unfortunately, adequate data on the non-target toxicity of aquatic herbicides to aquatic resources are lacking, thereby threatening the permitting process and the success of IPM strategies. Recent declines in several species/stocks of salmon and the emphasis of management and regulatory agencies to restore these populations heighten concerns. Our objective was to determine if label application rates for three commonly used aquatic herbicides impair smoltification in juvenile Pacific salmon, using coho (*Oncorhynchus kisutch*) as a model. The herbicides and water concentrations selected for study were Sonar®PR (active ingredient: fluridone; 10, 90 ppb), REWARD® (active ingredient: diquat dibromide; 0.34, 1.37 ppm), and RENOVATE® (active ingredient:triclopyr; 0.75, 2.50 ppm). Fish (mean = 22g; 20 fish/tank) were exposed to the herbicides or negative control (4 tanks/treatment) for 96 h under static conditions (11 C) and then transferred directly into flowing seawater (salinity = 27 ppt; 10 C) for 14 d. Five fish per tank were sacrificed after exposure to the chemicals, and after 1, 7 and 14 d in seawater. Endpoints were survival, body weight and fork length, muscle water content, hepatosomatic index, plasma sodium and chloride concentrations, gill ATPase, and gill histology. Tests for each herbicide were conducted concurrently. Actual concentrations were similar to nominal with the exception of fluridone (1, 10 ppb) due to a calculation error. All fish survived the chemical exposures and the first 7 d in seawater. Two fish exposed to the low concentration of REWARD died during the second week in seawater. The fish were from the same tank; no mortality was observed in other three replicate tanks. Necropsies of the two fish did not reveal any gross anomalies. Statistically significant decreases in plasma Cl concentrations were detected in fish exposed to the low and high levels of RENOVATE and REWARD while in freshwater compared to controls. Significant decreases in plasma Na and Cl were observed in REWARD-exposed fish after 24 h in seawater. Effects were short-lived and plasma ion concentrations were similar among treated and control fish after 7 and 14 d in seawater. Hepatosomatic index and muscle water content did not differ between treated fish and controls in either fresh or seawater. A few differences were detected in gill ATPase between treated and control fish, but effects were not consistent. Data on gill histology have yet to be analyzed statistically. Preliminary results suggest that, at the chemical and seawater exposures tested, the herbicides are unlikely to affect seawater adaptation in free-living juvenile Pacific salmon.

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*Mammals*

There are two common routes of exposure of livestock and terrestrial wildlife to aquatic applications of Renovate®. The two routes are exposure through drinking water treated with products containing triclopyr or eating aquatic plants, fish, or other aquatic organisms from the treatment site. Based on acute and chronic studies, triclopyr and its products used as aquatic herbicides do not pose a significant acute or chronic risk to terrestrial mammals.

*Threatened and Endangered Species*

Minimal effects to threatened and endangered species are expected from application of aquatic herbicides containing triclopyr. Mitigation of possible effects on listed endangered species is best accomplished by following the mitigation sections for terrestrial plants, birds and animals. As stated previously, the best way to mitigate possible effects on all terrestrial species is to follow the directions listed on the label.

Other mitigation measures involve the contact of WDFW by the issuer of the permit to ascertain if any endangered species may be affected by the application of the chemical to the water body in question. Questions asked by the permit granter would ascertain if any resident endangered bird or animal species are known to use the water body in question (or its shorelines or islands) as breeding or forage areas, or if the application coincides with the migration of any endangered species. If endangered species are present, mitigation measures may involve postponing application until after the breeding season or postponement of application until after migration of the species in question. Use of an alternate means of control (i.e. mechanical) may also be an option if the risk is determined to be too great to the species in question.

### *Permit Mitigation*

*Invertebrate biota*
*Wetland species*
*Fish*

Use as directed by the label.

*Avain*

- If the chemicals are applied according to the label, the effect on terrestrial wildlife should be minimal. Even though triclopyr products used as aquatic herbicides do not pose a significant risk to terrestrial wildlife, the following measures should be considered prior to all aquatic herbicide applications. One possible mitigation measure would be not allowing applications if large populations of birds use shorelines or islands in the water body to be treated for nesting until after nesting is complete. Another mitigation measure would be to time applications to avoid migratory waterfowl and other bird species that use certain water bodies during migration. Efforts to avoid effects on migratory and nesting birds would best be coordinated with The Washington State Department of Fish and Wildlife (WDFW).

## Water, Land and Shoreline Use

*Public Water Supplies - Potable Water*

The Reference Dose (RfD), the amount of triclopyr residuals that could be consumed daily over a lifetime without adverse effects, was established at 0.05 mg/kg/day, based on the two-generation reproduction toxicity study in rats with a NOEL (no observed effect level) of 5.0 mg/kg/day, the lowest does tested. At the next dose level (25 mg/kg/day), an increased incidence of proximal tubular degeneration of the kidneys was observed in P1 and P2 parental rats in this study (EPA R.E.D. Facts, 1998).

Triclopyr and its toxic metabolite TCP degrade and dissipate rapidly through chemical, biological, and physical processes (Various authors in Houtman et al, 1997). Concentrations of triclopyr in sites with short half-lives will typically fall below the temporary drinking water tolerance within one to three days of application. In areas with short triclopyr half-lives, the metabolite TCP is often not detected after the day of treatment, but has been detected at concentrations of 0.05 to 0.14 ppm in Lake Seminole, Georgia (CSI, Volume 5, Sect. 3, p. 40).

*Potable Water*

It has also been proposed as part of the tolerance petition, that the potable water setback be 0.25 miles in order to ensure residue levels remain below 0.5 ppm (proposed allowable drinking water tolerance). This set back distance was based on the results of several field dissipation studies (Woodburn, 1988 Houtman et al, 1997, Foster et al, 1997). However, recent modeling work (Ritter and Peacock, 2000) indicates that the setback distance should vary with the concentration used and the number of acres treated. At the maximum use rate (2.5 ppm) used to treat >16 acres, the setback distance from potable water intakes should be at least 2000 feet.

*Ground Water*

Highly mobile and water soluble compounds are more likely to reach ground water. Triclopyr is highly mobile (Kd =0.165 to 0.975), and highly water soluble.

While triclopyr exceeds the mobility and persistence triggers used to recommend restricted use, triclopyr does not meet detection triggers for recommending restricted use due to limited monitoring data (Hoheisel et al, 1992 in EPA RED, 1998).

In one EPA study (EPA, 1992), three hundred seventy-nine wells were sampled for triclopyr, and only five detections of triclopyr residues in ground water were reported. All detections were far below levels of concern. The maximum concentration reported was 0.58 ppb.

Public water supply systems are not required to sample for triclopyr, as triclopyr is currently not regulated under the Safe Drinking Water Act (SDWA). There is no maximum contaminant level (MCL) or Drinking Water Lifetime Health Advisory (HAL) for triclopyr. However, there is a proposed MCL of 500 ppb and an estimated HAL of 350 ppb.

Due to the limited amount of data collected, it is difficult to determine if triclopyr will have an adverse impact on sensitive well recharge areas. Although EPA does not currently have surface or ground water advisories on triclopyr, surface and ground water studies may be necessary to determine the potential for triclopyr to leach under its new aquatic use labeling (EPA RED, 1998; Getsinger et al, 1997; Green et al, 1989; Getsinger et al, 2000; Petty et al, 1998 and Petty et al 1998).

*Swimming*

The only health concerns from triclopyr for swimming are minor eye irritation and exposure to children immediately after application. The risk of eye irritation and overexposure for children decreases rapidly because of dilution. A mandatory waiting time after application before swimming is allowed mitigates the risk.

Exposure and risk calculations were determined for hypothetical situations involving ingestion and dermal contact with treated water while swimming and drinking potable water. Calculation of triclopyr exposures utilized the swimmer's weight, the skin surface area available for exposure, the amount of time spent in the treated water containing 2.5 and 0.5 ppm triclopyr, amount of water swallowed while swimming over specific time periods, and the estimated human skin permeability coefficient.

Risk analyses were completed for various populations. The most sensitive population was found to be children who swim for three hours and ingest water while swimming. However, a child would have to ingest 3.5 gallons of lake water where triclopyr had been recently applied to cause risk factors to be exceeded.

Based on the label use directions and the results of the triclopyr toxicology studies, the aggregate or combined daily exposure to the chemical from aquatic herbicidal weed control does not pose an adverse health concern.

The Washington State Dept. of Health has recommended a 12-hour restriction for re-entry into triclopyr treated water to assure that the eye irritation potential and any other adverse effects will not occur. WDOH also recommends that those wanting to avoid even small exposures can wait one to two weeks following application when the triclopyr residues have dissipated from the water and sediments (WDOH, 1999).

*Drift*

The main methods of using Renovate® and Garlon® 3A largely preclude the effects of drift. This liquid product is either injected by subsurface methods (which precludes drift) or applied as large droplets at low pressure which mitigates the effects of drift. It is also recommended that a thickening agent be used to control drift when applying liquid herbicides to the water surface or to wetland associated weeds.

The Garlon® 3A proposed label states the following: "Applications should be made only when there is little or no hazard from spray drift. Very small quantities of spray, which may not be visible, may seriously injure susceptible plants. Do not spray when wind is blowing toward susceptible crops or ornamental plants are near enough to be injured. It is suggested that a continuous smoke column at or near the spray site or a smoke generator on the spray equipment be used to detect air movement, lapse conditions, or temperature inversions (stable air). If the smoke layers or indicates a potential of hazardous spray drift, do not spray." Spray pressures should be kept low enough to provide course droplets. The spray boom should be kept as close to the ground or water surface as possible. In addition, a thickening agent or a high viscosity inverting system should be used to prevent drift.

### *Permit Mitigation*

*Water intakes and Drinking water*

Follow label instructions.

*Irrigation*

Follow label directions

*Ground Water*

- Use according to label directions. Ground water or sediment monitoring is required prior to any third application of triclopyr on a previously treated site planned within a three-year period. Evidence of persistence of triclopyr or TCP in sediment or ground water is basis for denial of the third application.

*Swimming*

- The Washington State Dept. of Health has recommended a 12-hour restriction for re-entry into triclopyr treated water to assure that the eye irritation potential and any other adverse effects will not occur. WDOH also recommends that those wanting to avoid even small exposures can wait 1-2 weeks following application when the triclopyr residues have dissipated from the water and sediments (WDOH, 1999).

*Fish Consumption*
*Agriculture*
*Irrigation*

Follow label directions.

*Data Gaps and Considerations*

Since triclopyr bioaccumulates at low levels (~1.0 to 2.0 in crayfish and clams), further evaluation of the accumulation effects of triclopyr on clams and crayfish should be considered before establishing residue tolerance limits on these species. The current proposed residue tolerance for fish and shellfish is 0.2 ppm.

Wetland (forestry) herbicides may be of particular concern to Native Americans. Forestry products are harvested by Native Americans and are used in their diets, in the making of traditional basketry, for medicinal purposes and ceremonial activities. Work is currently being conducted to determine if these exposure scenarios may affect Native Americans in a manner not reflected in the current assessment.

No laboratory work was conducted on the effects of triclopyr TEA against amphibians. It is anticipated that amphibians will be affected by triclopyr TEA both acutely ($LC_{50}$ = 82 to 182 ppm a.e. = 114 to 254 ppm a.i.) and chronically (MATC = 27 to 61 ppm a.e. = 38 to 93 ppm a.i.) at concentrations similar to that affecting fish. What little data is available from the field indicates that *Rana pipiens* adults and tadpoles remain common 11 weeks after treatment of the Columbia, Missouri pond site at rates of 2.5 ppm a.e. (Petty et al, 1998).

## 4. Mitigation Summary for Triclopyr TEA

| **Conditions of Treatment** | **Mitigation** |
|---|---|
| Drift | Follow label directions. |
| Odor | Aerial applications are not allowed so this should not be an issue. |
| Inhalation | Persons involved with mixing or applying should follow the directions on the label for safety. Application should be by direct injection under the water and not applied by aerial or spray application. |
| Irrigation | Follow label directions. |
| Surface water/fish and other aquatic life | Follow label directions. |
| Wetlands, estuaries and marshes that treated water may flow into. | The total application of these products should not exceed 2.5 ppm a.e. for the treatment area per annual growing season.<br>The total application of these products to control floating and emerged weeds should not exceed 2 gallons formulation/acre per annual growing season. |
| Non-target plants, including endangered plant species | The total application of these products should not exceed 2.5 ppm a.e. for the treatment area per annual growing season. |
| Invertebrates | If triclopyr TEA is treated as a restricted use herbicide, it should not cause adverse impact to the invertebrate biota. |

| | |
|---|---|
| Birds | Do not apply when large populations of birds use shorelines or islands in the water body to be treated for nesting until after nesting is complete. Avoid migratory waterfowl and other bird species that use certain water bodies during migration. |
| Threatened and endangered species | Mitigation of possible effects on listed endangered species is best accomplished by following the mitigation sections for terrestrial plants, birds and animals.<br><br>Follow the directions listed on the label.<br><br>Other mitigation measures involve the contact of WDFW by the issuer of the permit to ascertain if any endangered species may be affected by the application of the chemical to the water body in question. |
| Swimming | The Washington State Dept. of Health has recommended a 12-hour restriction for re-entry into triclopyr treated water to assure that the eye irritation potential and any other adverse effects will not occur. WDOH also recommends that those wanting to avoid even small exposures can wait 1-2 weeks following application when the triclopyr residues have dissipated from the water and sediments (WDOH, 1999). |
| Potable Water | Follow label directions. |
| Fishing/Fish consumption/shellfish consumption | Follow label directions. |
| Ground water | Use according to label directions. Ground water or sediment monitoring is required prior to any third application of triclopyr on a previously treated site planned within a three-year period. Evidence of persistence of triclopyr or TCP in sediment or ground water is basis for denial of the third application. |

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The primary reference for this document is the Supplemental Environment Impact Statement Assessments of Aquatic Herbicides: Study No. 00713, Volume 5, Triclopyr, by Compliance Services International, Tacoma, Washington, submitted to the Dept. of Ecology under a grant contract. The five sections are as follows:

Section 1 – Label Description & History, 65 pp.
Section 2 – Chemical Characteristics, 10 pp.
Section 3 – Environmental Fate, 94 pp.
Section 4 – Environmental Effects, 160 pp.
Section 5 – Human Health Effects, 47 pp.

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